

SEMI PV16-0611

SPECIFICATIONS FOR NITRIC ACID, USED IN PHOTOVOLTAIC APPLICATIONS

This Standard was technically approved by the global Photovoltaic Committee. This edition was approved for publication by the global Audits & Reviews Subcommittee on May 13, 2011. Available at www.semiviews.org and www.semi.org in June 2011.

1 Purpose

1.1 This document standardizes requirements for nitric acid used in the photovoltaic industry and testing procedures to support those standards. Test methods have been shown to give statistically valid results.

2 Scope

2.1 The scope of this document is grades of nitric acid used in the photovoltaic industry.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 None.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI C1 — Guide for the Analysis of Liquid Chemicals

SEMI C35 — Specifications and Guideline for Nitric Acid

4.2 ASTM Standard¹

ASTM D5127 — Standard Guide for Ultra Pure Water Used in the Electronics and Semiconductor Industries

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 None.

6 Properties of Nitric Acid

Table 1 Properties of Nitric Acid (for information only)

Chemical Formula	HNO ₃
CAS Number	7697-37-2
Density at 25°C	1.42 g/mL
Assay	65.0% to 70.0%

7 Requirements

7.1 The requirements for nitric acid for PV Grades 1 and 2 are listed in Table 2.

¹ American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA; Telephone: 610.832.9585, Fax: 610.832.9555, <http://www.astm.org>

Table 2 Impurity Limits and Other Requirements for Nitric Acid

	<i>PV Grade 1</i>	<i>PV Grade 2</i>
	<i>(Specifications)</i>	<i>(Specification)</i>
Assay (HNO ₃)	65% to 70.0%	69.0% to 70.0%
Color (APHA)	10 max.	10 max.
Chloride (Cl)	500 ppb max.	80 ppb max.
Phosphate (PO ₄)	--	200 ppb max.
Sulfate (SO ₄)	1000 ppb max.	500 ppb max.
Aluminum (Al)	50 ppb max.	5 ppb max.
Antimony (Sb)	50 ppb max.	10 ppb max.
Arsenic (As)	50 ppb max.	10 ppb max.
Barium (Ba)	--	10 ppb max.
Boron (B)	50 ppb max.	10 ppb max.
Cadmium (Cd)	10 ppb max.	5 ppb max.
Calcium (Ca)	100 ppb max.	10 ppb max.
Chromium (Cr)	50 ppb max.	10 ppb max.
Copper (Cu)	20 ppb max.	10 ppb max.
Iron (Fe)	300 ppb max.	5 ppb max.
Lead (Pb)	50 ppb max.	10 ppb max.
Lithium (Li)	--	5 ppb max.
Magnesium (Mg)	100 ppb max.	10 ppb max.
Manganese (Mn)	100 ppb max.	10 ppb max.
Nickel (Ni)	50 ppb max.	10 ppb max.
Potassium (K)	100 ppb max.	5 ppb max.
Sodium (Na)	300 ppb max.	5 ppb max.
Tin (Sn)	50 ppb max.	10 ppb max.
Titanium (Ti)	100 ppb max.	10 ppb max.
Vanadium (V)	--	10 ppb max.
Zinc (Zn)	50 ppb max.	10 ppb max.

8 PV Grade 1 Procedures

NOTE 1: Each laboratory is responsible for verifying the validity of the method within its own operation.

8.1 *Assay* — Accurately weigh a small glass-stoppered conical flask containing about 15 mL of water. Deliver from a pipet about 2 mL of the sample near the water surface, stopper immediately, cool, and reweigh. Dilute to about 50 mL with water, add 0.10 mL of methyl orange indicator solution, and titrate with standardized 1 N sodium hydroxide to a red to yellow color change.

$$\% \text{Assay} = \frac{\text{Volume of NaOH (mL)} \times \text{Normality of NaOH} \times 6.301}{\text{Mass of sample (g)}} \quad (1)$$

8.2 *Color* — Dilute 2.0 mL of platinum-cobalt stock solution (APHA No. 500, see SEMI C1) to 100 mL with water. Compare this standard (APHA No. 10) with 100 mL of sample in Nessler tubes. View vertically over a white background. The sample must be no darker than the standard.

8.3 *Chloride* — Dilute 17 mL (24 g) of sample with 10 mL of water, add 1 mL of silver nitrate reagent solution (see SEMI C1), and evaporate to dryness on a steam bath in a hood. Dissolve the residue in 0.5 mL of ammonium